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ABSTRACT

This curriculum outline is a compilation of student learning objectives for modules 1-14 of the military-developed basic electricity and electronics course. The course is one of a number of military-developed curriculum packages selected for adaptation to vocational instructional and curriculum development in civilian settings. For each module, the outline provides the estimated contact hours required for completion, module terminal objectives, and a list of supporting modules. Information provided for each lesson within the modules includes the lesson title, estimated contact hours, terminal objectives, and enabling objectives. (LRA)

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ED190875

CHIEF OF NAVAL TECHNICAL TRAINING

JULY 1978

Military Curricula for Vocational & Technical Education

CURRICULUM OUTLINE FOR BASIC ELECTRICITY AND ELECTRONICS

CE 026 560

U.S. DEPARTMENT OF HEALTH,
EDUCATION & WELFARE
NATIONAL INSTITUTE OF
EDUCATION

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THE NATIONAL CENTER
FOR RESEARCH IN VOCATIONAL EDUCATION
THE OHIO STATE UNIVERSITY

MILITARY CURRICULUM MATERIALS

The military-developed curriculum materials in this course package were selected by the National Center for Research in Vocational Education Military Curriculum Project for dissemination to the six regional Curriculum Coordination Centers and other instructional materials agencies. The purpose of disseminating these courses was to make curriculum materials developed by the military more accessible to vocational educators in the civilian setting.

The course materials were acquired, evaluated by project staff and practitioners in the field, and prepared for dissemination. Materials which were specific to the military were deleted, copyrighted materials were either omitted or approval for their use was obtained. These course packages contain curriculum resource materials which can be adapted to support vocational instruction and curriculum development.

Military Curriculum Materials Dissemination Is . . .

an activity to increase the accessibility of military-developed curriculum materials to vocational and technical educators.

This project, funded by the U.S. Office of Education, includes the identification and acquisition of curriculum materials in print form from the Coast Guard, Air Force, Army, Marine Corps and Navy.

Access to military curriculum materials is provided through a "Joint Memorandum of Understanding" between the U.S. Office of Education and the Department of Defense.

The acquired materials are reviewed by staff and subject matter specialists, and courses deemed applicable to vocational and technical education are selected for dissemination.

The National Center for Research in Vocational Education is the U.S. Office of Education's designated representative to acquire the materials and conduct the project activities.

Project Staff:

Wesley E. Budke, Ph.D., Director
National Center Clearinghouse

Shirley A. Chase, Ph.D.
Project Director

What Materials Are Available?

One hundred twenty courses on microfiche (thirteen in paper form) and descriptions of each have been provided to the vocational Curriculum Coordination Centers and other instructional materials agencies for dissemination.

Course materials include programmed instruction, curriculum outlines, instructor guides, student workbooks and technical manuals.

The 120 courses represent the following sixteen vocational subject areas:

- Agriculture
- Aviation
- Building & Construction Trades
- Clerical Occupations
- Communications
- Drafting
- Electronics
- Engine Mechanics
- Food Service
- Health
- Heating & Air Conditioning
- Machine Shop
- Management & Supervision
- Meteorology & Navigation
- Photography
- Public Service

The number of courses and the subject areas represented will expand as additional materials with application to vocational and technical education are identified and selected for dissemination.

How Can These Materials Be Obtained?

Contact the Curriculum Coordination Center in your region for information on obtaining materials (e.g., availability and cost). They will respond to your request directly or refer you to an instructional materials agency closer to you.

CURRICULUM COORDINATION CENTERS

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Springfield, IL 62777
217/782-0759

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The National Center Mission Statement

The National Center for Research in Vocational Education's mission is to increase the ability of diverse agencies, institutions, and organizations to solve educational problems relating to individual career planning, preparation, and progression. The National Center fulfills its mission by:

- Generating knowledge through research
- Developing educational programs and products
- Evaluating individual program needs and outcomes
- Installing educational programs and products
- Operating information systems and services
- Conducting leadership development and training programs

FOR FURTHER INFORMATION ABOUT
Military Curriculum Materials
WRITE OR CALL
Program Information Office
The National Center for Research in Vocational Education
The Ohio State University
1960 Kenny Road, Columbus, Ohio 43210
Telephone: 614/486-3655 or Toll Free 800/848-4815 within the continental U.S. (except Ohio)

THE NATIONAL CENTER
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Military Curriculum Materials for Vocational and Technical Education

Information and Field Services Division

The National Center for Research in Vocational Education

COVER PAGE

1. Course title:

   BASIC ELECTRICITY AND ELECTRONICS

2. Estimated average completion time:

   132 contact hours

3. Locations at which taught:

   SSC, NTC SAN DIEGO
   SSC, NTC GREAT LAKES
   NATTC, NAS MEMPHIS
   SSC, NTC ORLANDO

4. Maximum input per week:

   100

5. Learning supervisors required:

   Based on maximum input per week:
   66

6. Activity preparing curriculum outline:

   CURRICULUM AND INSTRUCTIONAL STANDARDS DIVISION
   NATTC, NAS MEMPHIS

7. Command exercising curriculum control:

   CHIEF OF NAVAL TECHNICAL TRAINING
   NAS MEMPHIS

8. Quota management authority:

9. Quota control:

10. Approval/implementation date:

FOREWORD

This curriculum outline contains all the learning objectives for the many ratings in the Basic Electricity and Electronics training pipeline. Individual students are required to achieve only those designated objectives applicable to their career fields or those that are prerequisites for follow-on A-1 schools.

The module and course contact hours are derived from initial validations, and they are subject to revision upon implementation of this course. Staff and equipment requirements for implementation of this curriculum are based on those of a hypothetical school with a maximum input of 100 students per week.

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COURSE DATA PAGE

1. COURSE MISSION:

To train personnel who are ordered to specific A-1 schools to demonstrate the applied skills and knowledge of basic electricity and electronics that have been designated by each of the schools to be entry-level prerequisites.

2. RECOMMENDED PERSONNEL PHYSICAL REQUIREMENTS:

As required by the *Manual of Qualifications for Advancement*, NAVPERS-18068-C, for the specific school the student is to attend.

3. SECURITY CLEARANCE REQUIRED:

Unclassified

4. RECOMMENDED PREREQUISITE TRAINING:

None

5. PERSONNEL AND RATINGS ELIGIBLE:

6. OBLIGATED SERVICE:

7. NOBC/NEC EARNED:

8. RELATED AND/OR FOLLOW-ON TRAINING:

9. MODULES SPECIFIED FOR THE RATING:

MODULE 1.0. BASIC VOLTAGE AND CURRENT MEASUREMENTS IN A SIMPLE CIRCUIT.

Estimated contact hours allotted this module: learning center, 4.5 hours.

TERMINAL OBJECTIVES

Supported entirely by this module.

When the student completes this course, he will be able to:

1.0. Construct a simple d-c circuit, using a schematic diagram, given component parts and a schematic diagram of a cell, a lamp, a switch, and conductors. Standard is 100 percent.

2.0. Measure current in a simple d-c circuit constructed according to a given schematic diagram, given the necessary components and a basic ammeter. Observe equipment and personal safety precautions. Measured values must be within the meter's tolerance.

3.0. Measure voltages in a simple d-c circuit constructed according to a given schematic diagram. Given components parts and a basic voltmeter, make measurements in series-aiding and parallel circuits. Observe personal safety precautions and follow proper equipment protection procedures. Measured values must be within the meter's tolerance.

Supported partially by this module and partially by all other modules.

0.0. Comply with all established safety precautions concerning personal well-being; operate and handle all equipment properly.

Supported partially by this module and partially by modules 2, 3, 4, 5, 6, 7, 9, 10, and 11.

6.0. Use schematics of circuits to trace circuits, identify circuit configurations, identify components and component values, and locate faults in operating circuits.

LESSON TOPIC 1.1.1. CONSTRUCTING A SIMPLE CIRCUIT.

Estimated contact hours allotted lesson topic: learning center, 1.0 hour.

TERMINAL OBJECTIVE

Supported entirely by this lesson topic.

When the student completes this course, he will be able to:

1.0. Construct a simple d-c circuit, using a schematic diagram, given component parts and a schematic diagram of a cell, a lamp, a switch, and conductors. Standard is 100 percent.

ENABLING OBJECTIVES

Supported entirely by this lesson topic.

When the student completes this lesson topic, he will be able to:

1.1. IDENTIFY schematic symbols (a d-c power source, a lamp, a switch, and a conductor) by matching schematic symbols with their names. Standard is 100 percent.

1.2. SELECT schematics of circuits connected so that current can flow, given five schematics, only two of which are correct. Standard is 100 percent.

LESSON TOPIC 1.2.1. MEASURING CURRENT IN A SIMPLE CIRCUIT.

Estimated contact hours alloted lesson topic: learning center, 1.0 hour.

TERMINAL OBJECTIVE

Supported entirely by this lesson:

When the student completes this course, he will be able to:

2.0. Measure current in a simple d-c circuit constructed according to a given schematic diagram, given the necessary components and a basic ammeter. Observe equipment and personal safety precautions. Measured values must be within the meter's tolerance.

ENABLING OBJECTIVES

Supported entirely by this lesson topic.

When the student completes this lesson topic, he will be able to:

2.1. IDENTIFY a correctly installed ammeter by selecting the correct schematic. Standard is 100 percent.

2.2. IDENTIFY the current path in a simple d-c circuit with an ammeter correctly installed, by selecting the correct illustration. Standard is 100 percent.

LESSON TOPIC 1.3.1. MEASURING VOLTAGE IN A SIMPLE CIRCUIT.

Estimated contact hours allotted lesson topic: learning center, 2.0 hours.

TERMINAL OBJECTIVE

Supported entirely by this lesson topic:

When the student completes this course, he will be able to:

3.0. Measure voltages in a simple d-c circuit constructed according to a given schematic diagram. Given component parts and a basic voltmeter, make measurements in series-aiding and parallel circuits. Observe personal safety precautions and follow proper equipment protection procedures. Measured values must be within the meter's tolerance.

ENABLING OBJECTIVES

Supported entirely by this lesson topic.

When the student completes this lesson topic, he will be able to:

3.1. IDENTIFY the connection of a voltmeter to measure the voltage across a component, by selecting an illustration. Standard is 100 percent.

3.2. SELECT a statement that identifies the correct polarities of the terminals of the basic voltmeter. Standard is 100 percent.

3.3. IDENTIFY a correctly connected voltmeter by selecting a statement that describes this connection. Standard is 100 percent.

3.4. DETERMINE and SELECT the correct total voltage applied in a circuit, given a schematic diagram containing series or parallel battery arrangements. Standard is 100 percent.

MODULE 2.0. RELATIONSHIPS OF VOLTAGE, CURRENT, AND RESISTANCE.

Estimated contact hours allotted this module: learning center, 7.0 hours.

TERMINAL OBJECTIVES

Supported entirely by this module.

When the student completes this course, he will be able to:

4.0. Identify the factors in Ohm's law and define the characteristics and relationships of each by selecting a statement about Ohm's law. Standard is 100 percent.

5.0. Determine normal circuit conditions in a d-c series circuit by theoretical analysis and the application of rules and laws concerning voltage, resistance, and current relationships in multielement d-c series circuits. Standard is 100 percent.

6.0. Use schematics of circuits to trace circuits, identify circuit configurations, identify components and component values, and locate faults in operating circuits. Standard is 100 percent.

7.0. Determine the ohmic values of given resistors by using the color codes, given an illustration of a resistor with the color bands identified. Standard is 100 percent.

LESSON TOPIC 2.4.1. CHARACTERISTICS OF VOLTAGE.

Estimated contact hours allotted lesson topic: learning center, 0.5 hour.

TERMINAL OBJECTIVE

Supported partially by this lesson topic and by lesson topics 2.4.2, 2.4.3, 2.4.4, and 2.4.5.

4.0. Identify the factors in Ohm's law and define the characteristics and relationships of each by selecting a statement about Ohm's law. Standard is 100 percent.

ENABLING OBJECTIVES

Supported entirely by this lesson topic:

When the student completes this lesson topic, he will be able to:

4.1. DEFINE voltage by selecting the definition. Standard is 100 percent.

4.1.1. IDENTIFY the basic unit of measurement of voltage by selecting the unit. Standard is 100 percent.

4.1.2. IDENTIFY the abbreviations for the terms *voltage* and *volt* by selecting the abbreviations. Standard is 100 percent.

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LESSON TOPIC 2.4.2. CURRENT FLOW.

Estimated contact hours allotted lesson topic: learning center, 0.5 hour.

TERMINAL OBJECTIVE

Supported partially by this lesson topic and by lesson topics 2.4.1, 2.4.3, 2.4.4, and 2.4.5.

4.0. Identify the factors in Ohm's law and define the characteristics and relationships of each by selecting a statement about Ohm's law. Standard is 100 percent.

ENABLING OBJECTIVES

Supported entirely by this lesson topic.

When the student completes this lesson topic, he will be able to:

4.2. DEFINE current flow by selecting the definition. Standard is 100 percent.

4.2.1. IDENTIFY the abbreviation for current by selecting the abbreviation. Standard is 100 percent.

4.2.2. IDENTIFY the basic unit of measurement of current flow by selecting the unit. Standard is 100 percent.

4.2.2.1. DEFINE free electrons by selecting the definition. Standard is 100 percent.

4.2.2.2. DESCRIBE the theoretical movement of electrons by selecting a statement. Standard is 100 percent.

4.2.2.3. IDENTIFY the outermost particle that orbits the nucleus of an atom by selecting the name of the particle. Standard is 100 percent.

4.2.2.4. IDENTIFY the basic particles that compose the nucleus of an atom by selecting a statement about the particles. Standard is 100 percent.

4.2.2.5. IDENTIFY a neutral atom by selecting a description. Standard is 100 percent.

4.2.2.6. EXPRESS the law of charged bodies by selecting a statement about the law of charged bodies. Standard is 100 percent.

LESSON TOPIC 2.4.3. CONVERSION OF ELECTRICAL UNITS.

Estimated contact hours allotted lesson topic: learning center, 0.5 hour.

TERMINAL OBJECTIVE

Supported partially by this lesson topic and by lesson topics 2.4.1, 2.4.2, 2.4.4, and 2.4.5.

When the student completes this course, he will be able to:

4.0. Identify the factors in Ohm's law and define the characteristics and relationships of each by selecting a statement about Ohm's law. Standard is 100 percent.

ENABLING OBJECTIVES

Supported entirely by this lesson topic.

When the student completes this lesson topic, he will be able to:

4.1.3. CONVERT volts and amperes to milli and micro values by selecting the correct conversions. Standard is 100 percent.

4.1.4. DEFINE *kilo, micro, milli*, and *mega* by selecting their numerical values. Standard is 100 percent.

4.2.3. CONVERT numerical values to kilo and mega values by selecting the correct conversions. Standard is 100 percent.

4.2.3.1. CONVERT numerical values to powers of 10 and scientific notation by selecting the correct conversions. Standard is 100 percent.

LESSON TOPIC 2.4.4. RESISTANCE.

Estimated contact hours allotted lesson topic: learning center, 0.5 hour.

TERMINAL OBJECTIVE

Supported partially by this lesson topic and by lesson topics 2.4.1, 2.4.2, 2.4.3, and 2.4.5.

When the student completes this course, he will be able to:

4.0. Identify the factors in Ohm's law and define the characteristics and relationships of each by selecting a statement about Ohm's law. Standard is 100 percent.

ENABLING OBJECTIVES

Supported entirely by this lesson topic.

When the student completes this lesson topic, he will be able to:

4.3. DEFINE resistance by selecting the definition. Standard is 100 percent.

4.3.1. IDENTIFY the abbreviation for resistance by selecting the abbreviation. Standard is 100 percent.

4.3.2. IDENTIFY the symbol for the unit of measurement of resistance by selecting the symbol. Standard is 100 percent.

4.3.3. IDENTIFY the basic unit of measurement of resistance by selecting the unit. Standard is 100 percent.

LESSON TOPIC 2.4.5. OHM'S LAW.

Estimated contact hours allotted lesson topic: learning center, 0.5 hour.

TERMINAL OBJECTIVE

Supported partially by this lesson topic and by lesson topics 2.4.1, 2.4.2, 2.4.3, and 2.4.4.

When the student completes this course, he will be able to:

4.0. Identify the factors in Ohm's law and define the characteristics and relationships of each by selecting a statement about Ohm's law. Standard is 100 percent.

ENABLING OBJECTIVES

Supported entirely by this lesson topic.

When the student completes this lesson topic, he will be able to:

4.5.1. Identify the relationship between the factors in Ohm's law by selecting a statement about Ohm's law. Standard is 100 percent.

LESSON TOPIC 2.5.1. VOLTAGE IN A SERIES D-C CIRCUIT.

Estimated contact hours allotted lesson topic: learning center, 1.0 hour.

TERMINAL OBJECTIVE

Supported partially by this lesson topic and by lesson topic 2.5.2.

When the student completes this course, he will be able to:

5.0. Determine normal circuit conditions in a d-c series circuit by theoretical analysis and the application of rules and laws concerning voltage, resistance, and current relationships in multielement d-c series circuits. Standard is 100 percent.

ENABLING OBJECTIVES

Supported entirely by this lesson topic.

When the student completes this lesson topic, he will be able to:

5.1. IDENTIFY the current path and the voltage source in a series d-c circuit. Given a schematic diagram, select the current path and the direction of current flow. Standard is 100 percent.

5.1.1. IDENTIFY a voltage drop in a series d-c circuit. Given a schematic diagram and component values, select the value that indicates a voltage drop. Standard is 100 percent.

5.1.1.1. SOLVE for the total voltage drop in a series d-c circuit, given a schematic diagram with component values. All values must be within an accuracy of 10 percent.

LESSON TOPIC 2.5.2. APPLICATION OF OHM'S LAW.

Estimated contact hours allotted lesson topic: learning center, 1.5 hours.

TERMINAL OBJECTIVE

Supported partially by this lesson topic and by lesson topic 2.5.1.

When the student completes this course, he will be able to:

5.0. Determine normal circuit conditions in a d-c series circuit by theoretical analysis and the application of rules and laws concerning voltage, resistance, and current relationships in multielement d-c series circuits. Standard is 100 percent.

ENABLING OBJECTIVES

Supported entirely by this lesson topic.

When the student completes this lesson topic, he will be able to:

5.1.2. APPLY Ohm's law. Given two values, solve for the unknown value. Standard is 100 percent.

5.1.2.1. SOLVE for current in a series d-c circuit, given a schematic diagram and the values of voltage and resistance. Standard is 100 percent.

5.1.2.2. SOLVE for the applied voltage in a series d-c circuit, given a schematic diagram and the values of resistance and current. Standard is 100 percent.

5.1.2.3. SOLVE for voltage drops in a series d-c circuit, given a schematic diagram and the values of current and resistance. Standard is 100 percent.

5.1.2.4. IDENTIFY the basic unit of power by selecting the unit. Standard is 100 percent.

5.1.2.5. SOLVE for the total power dissipated in a series d-c circuit, given the values of current and resistance. Standard is 100 percent.

5.2. SOLVE for the total resistance of a series d-c circuit, given the values of voltage and current. Standard is 100 percent.

LESSON TOPIC 2.6.1. SCHEMATIC SYMBOLS.

Estimated contact hours allotted lesson topic: learning center, 0.5 hour.

TERMINAL OBJECTIVE

Supported entirely by this lesson topic.

When the student completes this course, he will be able to:

6.0. Use schematics of circuits to trace circuits, identify circuit configurations, identify components and component values, and locate faults in operating circuits. Standard is 100 percent.

ENABLING OBJECTIVES

Supported entirely by this lesson topic.

When the student completes this lesson topic, he will be able to:

6.1. IDENTIFY schematic symbols of a source, load, and conductor by matching schematic symbols with their names. Standard is 100 percent.

6.2. IDENTIFY the schematic symbol of a fixed resistor by matching the schematic symbol with its name. Standard is 100 percent.

6.3. IDENTIFY the schematic symbol of a tapped resistor by matching the schematic symbol with its name. Standard is 100 percent.

6.4. IDENTIFY the schematic symbol of a potentiometer by matching the schematic symbol with its name. Standard is 100 percent.

6.5. IDENTIFY the schematic symbol of a rheostat by matching the schematic symbol with its name. Standard is 100 percent.

LESSON TOPIC 2.7.1. COLOR CODE FOR RESISTORS.

Estimated contact hours allotted lesson topic: learning center, 0.5 hour.

TERMINAL OBJECTIVE

Supported entirely by this lesson topic.

When the student completes this course, he will be able to:

7.0. Determine the ohmic values of given resistors by using the color codes, given an illustration of a resistor with the color bands identified. Standard is 100 percent.

ENABLING OBJECTIVES

Supported entirely by this lesson topic.

When the student completes this lesson topic, he will be able to:

7.1. IDENTIFY the ohmic values indicated by the resistor color codes by selecting the ohmic values, given descriptive statements. Standard is 100 percent.

7.2. IDENTIFY the bands on a resistor that indicate the given value of resistance by selecting the correct sequence of color bands. Standard is 100 percent.

7.3. IDENTIFY the band on a resistor that indicates the resistive tolerance by selecting the correct band from a given illustration. Standard is 100 percent.

MODULE 3.0. USE OF THE SIMPSON 260-5P MULTIMETER

Estimated contact hours allotted this module: learning center, 8.0 hours.

TERMINAL OBJECTIVES

Supported entirely by this module.

When the student completes this course, he will be able to:

8.0. Operate a multimeter to measure values of resistance in d-c circuits and record the values, given a Simpson 260-5P and series d-c circuits containing at least three resistors. Observe personal safety precautions and follow proper equipment protection procedures. All values will be measured within the tolerance of the meter.

9.0. Operate a multimeter to measure current in d-c circuits and record the values, given a Simpson 260-5P and series d-c circuits containing at least three resistors. Observe personal safety precautions and follow proper equipment protection procedures. All values will be measured within the tolerance of the meter.

10.0. Operate a multimeter to measure values of voltage in a d-c circuit and record the values, given a Simpson 260-5P and a series d-c circuit containing at least three resistors. Observe personal safety precautions and follow proper equipment protection procedures. All values will be measured within the tolerance of the meter.

LESSON TOPIC 3.8.1. SIMPSON 260-5P, RESISTANCE CONFIGURATION.

Estimated contact hours allotted lesson topic: learning center, 1.0 hour.

TERMINAL OBJECTIVE

Supported partially by this lesson topic and by lesson topics 3.8.2 and 3.8.3.

When the student completes this course, he will be able to:

8.0. Operate a multimeter to measure values of resistance in d-c circuits and record the values, given a Simpson 260-5P and series d-c circuits containing at least three resistors. Observe personal safety precautions and follow proper equipment protection procedures. All values will be measured within the tolerance of the meter.

ENABLING OBJECTIVES

Supported entirely by this lesson topic.

When the student completes this lesson topic, he will be able to:

8.1. IDENTIFY the parts of a Simpson 260-5P and their positions by matching the parts on an illustration of a Simpson 260-5P with their names. Standard is 100 percent.

8.1.5. IDENTIFY the scale on the face of the Simpson 260-5P that is used for measuring resistance. Given an illustration of a Simpson 260-5P, select the scale. Standard is 100 percent.

8.1.5.1. IDENTIFY the purpose of the symbol ∞ on the Simpson 260-5P and identify its location on the OHMS scale. Given an illustration of a Simpson 260-5P, select the correct statement. Standard is 100 percent.

8.1.2. IDENTIFY the resistance ranges on the Simpson 260-5P by selecting the ranges. Standard is 100 percent.

8.1.2.1. DETERMINE the value of measured resistance by selecting the value, given an illustration of the Simpson 260-5P range-switch setting and the meter indication. Standard is 100 percent.

8.1.1. IDENTIFY the position of the function switch used for measuring resistance. Given an illustration of a Simpson 260-5P multimeter, select the position for resistance measurement. Standard is 100 percent.

8.1.4. IDENTIFY the location of the ZERO OHMS adjust knob. Given an illustation of a Simpson 260-5P, select the location of the knob. Standard is 100 percent.

8.1.3. IDENTIFY the jacks on the front of the Simpson 260-5P that are used for measuring resistance. Given an illustration of a Simpson 260-5P, select the correct jacks. Standard is 100 percent.

8.1.6. IDENTIFY the lead connections of an ohmmeter used for measuring resistance. Given a schematic diagram and an illustration of the Simpson 260-5P, select the correct connections. Standard is 100 percent.

LESSON TOPIC 3.8.2. USING THE SIMPSON 260-5P TO MEASURE RESISTANCE.

Estimated contact hours allotted lesson topic: learning center, 1.0 hour.

TERMINAL OBJECTIVE

Supported partially by this lesson topic and by lesson topics 3.8.1 and 3.8.3.

When the student completes this course, he will be able to:

8.0. Operate a multimeter to measure values of resistance in d-c circuits and record the values, given a Simpson 260-5P and series d-c circuits containing at least three resistors. Observe personal safety precautions and follow proper equipment protection procedures. All values will be measured within the tolerance of the meter.

ENABLING OBJECTIVES

Supported entirely by this lesson topic.

When the student completes this lesson topic, he will be able to:

8.2. IDENTIFY a circuit that is safe for measuring resistance by selecting a schematic. Standard is 100 percent.

8.3. IDENTIFY the setup and the connection of a Simpson 260-5P for measuring resistance by selecting an illustration. Standard is 100 percent.

8.3.1. CONNECT test leads to a meter, following given instructions. Standards are within the limitations of the meter.

8.3.2. SET the function switch, following given instructions. Standards are within the limitations of the meter.

8.3.3. POSITION the range selector, following given instructions. Standards are within the limitations of the meter.

8.3.4. ZERO the meter, following given instructions. Standards are within the limitations of the meter.

8.3.5. PLACE the test probes, following given instructions. Standards are within the limitations of the meter.

8.3.6. READ the resistance, following given instructions. Standards are within the limitations of the meter.

8.3.7. CONVERT a meter reading to its true value, following given instructions. Standards are within the limitations of the meter.

8.3.8. SECURE the meter, following given instructions. Standards are within the limitations of the meter.

LESSON TOPIC 3.8.3. MEASURING RESISTANCE IN A D-C SERIES CIRCUIT.

Estimated contact hours allotted lesson topic: learning center, 2.0 hours.

TERMINAL OBJECTIVE

Supported partially by this lesson topic and by lesson topics 3.8.1 and 3.8.2.

When the student completes this course, he will be able to:

8.0. Operate a multimeter to measure values of resistance in d-c circuits and record the values, given a Simpson 260-5P and series d-c circuits containing at least three resistors. Observe personal safety precatuions and follow proper equipment protection procedures. All values will be measured within the tolerance of the meter.

LESSON TOPIC 3.9.1. SIMPSON 260-5P, CURRENT CONFIGURATION.

Estimated contact hours allotted lesson topic: learning center, 1.5 hours.

TERMINAL OBJECTIVE

Supported partially by this lesson topic and by lesson topic 3.9.2.

When the student completes this course, he will be able to:

9.0. Operate a multimeter to measure current in d-c circuits and record the values, given a Simpson 260-5P and series d-c circuits containing at least three resistors. Observe personal safety precautions and follow proper equipment protection procedures. All values will be measured within the tolerance of the meter.

ENABLING OBJECTIVES

Supported entirely by this lesson topic.

When the student completes this lesson topic, he will be able to:

9.1. IDENTIFY the parts of the Simpson 260-5P that are used for measuring current by matching the parts on an illustration of the Simpson 260-5P with their names. Standard is 100 percent.

9.1.1. IDENTIFY the position(s) in which the function switch must be to measure current. Given illustrations of the positions of the function switch, select the correct illustrations. Standard is 100 percent.

9.1.2. IDENTIFY the current-measuring capabilities of the Simpson 260-5P. Given an illustration of the scales of the Simpson 260-5P, select the current ranges and the values indicated. Standard is 100 percent.

9.1.3. IDENTIFY the connection of the multimeter test leads in a circuit in order to measure current. Given schematic diagrams and illustrations of test leads, select the illustration of the correct connection. Standard is 100 percent.

LESSON TOPIC 3.9.2. USING THE SIMPSON 260-5P TO MEASURE CURRENT.

Estimated contact hours allotted lesson topic: learning center, 1.5 hours.

TERMINAL OBJECTIVE

Supported partially by this lesson and by lesson topic 3.9.1.

When the student completes this course, he will be able to:

9.0. Operate a multimeter to measure current in d-c circuits and record the values, given a Simpson 260-5P and series d-c circuits containing at least three resistors. Observe personal safety precautions and follow proper equipment protection procedures. All values will be measured within the tolerance of the meter.

LESSON TOPIC 3.10.1. SIMPSON 260-5P VOLTAGE CONFIGURATION.

Estimated contact hours allotted lesson topic: learning center, 1.0 hour.

TERMINAL OBJECTIVE

Supported partially by this lesson topic and by lesson topic 3.10.2.

When the student completes this course, he will be able to:

10.0. Operate a multimeter to measure values of voltage in a d-c circuit and record the values, given a Simpson 260-5P and a series d-c circuit containing at least three resistors. Observe personal safety precautions and follow proper equipment protection procedures. All values will be measured within the tolerance of the meter.

ENABLING OBJECTIVES

Supported entirely by this lesson topic.

When the student completes this lesson topic, he will be able to:

10.1. IDENTIFY the maximum voltage-reading capability of the Simpson 260-5P. Given an illustration of the Simpson 260-5P, select the maximum voltage that can be read. Standard is 100 percent.

10.2. SELECT the correct setting of the range selector when an unknown voltage is measured. Given an illustration of the Simpson 260-5P, select the correct position. Standard is 100 percent.

10.3. IDENTIFY a properly connected voltmeter. Given a schematic diagram and an illustration of a Simpson 260-5P, select the proper connection.

LESSON TOPIC 3.10.2. USING THE SIMPSON 260-5P TO MEASURE VOLTAGE

Estimated contact hours allotted lesson topic: learning center, 1.0 hour.

TERMINAL OBJECTIVE

Supported partially by this lesson topic and by lesson topic 3.10.1.

When the student completes this course, he will be able to:

10.0. Operate a multimeter to measure values of voltage in a d-c circuit and record the values, given a Simpson 260-5P and a series d-c circuit containing at least three resistors. Observe personal safety precautions and follow proper equipment protection procedures. All values will be measured within the tolerance of the meter.

MODULE 4.0. VARIATIONAL ANALYSIS OF D-C SERIES CIRCUITS

Estimated contact hours allotted this module: learning center, 10.0 hours.

TERMINAL OBJECTIVE

Supported entirely by this module.

When the student completes this course, he will be able to:

11.0. Determine the effects on d-c series circuits of opens, shorts, and changing loads by theoretical analysis and the application of concepts concerning voltage, resistance, and current in a multielement d-c series circuit. Standard is 100 percent.

12.0. Determine the meter reading that would be recorded on an ammeter for an open or a shorted condition in a piece of equipment. Given a schematic diagram of a circuit containing an open or a short and showing multimeter connections, select the meter reading that would result from the conditions shown. Standard is 100 percent.

13.0. Locate opens and shorts in a d-c series circuit by measuring normal circuit voltage, resistance, and current and comparing these measurements with abnormal circuit values. Given a Simpson 260-5P, measure normal circuit conditions and record the values. Then take measurements in the same circuit with faults installed. All measurements are within the tolerance of the meter.

LESSON TOPIC 4.11.1. EFFECTS OF OPENS, SHORTS, CHANGING VOLTAGES, AND LOADS.

Estimated contact hours allotted lesson topic: learning center, 2.5 hours.

TERMINAL OBJECTIVE

Supported entirely by this lesson topic.

When the student completes this course, he will be able to:

11.0. Determine the effects on a d-c series circuit of opens, shorts, and changing loads by theoretical analysis and the application of concepts concerning voltage, resistance, and current in a multielement d-c series circuit. Standard is 100 percent.

ENABLING OBJECTIVES

Supported entirely by this lesson topic.

When the student completes this lesson topic, he will be able to:

11.1. IDENTIFY the probable cause of a change in current in a circuit. Given values of voltage, current, and resistance in a series circuit containing at least three resistors, select the correct condition. Standard is 100 percent.

11.1.1. IDENTIFY the effect on current in a circuit when the voltage is increased and the resistance remains the same. Given values of voltage, current, and resistance in a series circuit containing at least three resistors, select the correct condition. Standard is 100 percent.

11.1.1.1. IDENTIFY the effect on current in a circuit when the voltage is decreased and the resistance remains the same. Given values of voltage, current, and resistance in a series circuit containing at least three resistors, select the correct condition. Standard is 100 percent.

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11.1.2. DETERMINE the effect on current in a circuit when the resistance is increased and voltage remains the same. Given values of voltage, current, and resistance in a series circuit containing at least three resistors, select the correct condition. Standard is 100 percent.

11.1.2.1. DETERMINE the effect on current in a circuit when the resistance is decreased and voltage remains the same. Given values of voltage, current, and resistance in a series circuit containing at least three resistors, select the correct condition. Standard is 100 percent.

11.1.3. DETERMINE which resistor/s in a circuit will overheat if all resistors have the same wattage rating. Given values of voltage, current, and resistance in a series circuit containing at least three resistors, select the correct conditions. Standard is 100 percent.

11.2. DETERMINE conditions in a circuit when a short is inserted. Given values of voltage, current, and resistance in a series circuit containing at least three resistors, select the correct condition. Standard is 100 percent.

11.3. DETERMINE conditions in a circuit when an open is inserted. Given values of voltage, current, and resistance in a series circuit containing at least three resistors, select the correct conditions. Standard is 100 percent.

LESSON TOPIC 4.12.1. MEASURING VALUES OF A SERIES D-C CIRCUIT.

Estimated contact hours allotted lesson topic: learning center, 2.0 hours.

TERMINAL OBJECTIVE

Supported entirely by this lesson topic.

When the student completes this course, he will be able to:

12.0. Use the Simpson 260-5P to measure the values of voltage, current, and resistance in a series circuit containing indicated shorts and opens. Given a Simpson 260-5P and a test circuit of at least three components, locate opens and shorts. All measurements are within the tolerance of the meter.

12.1. Identify ohmmeter indications of open- and short-circuit conditions, by selecting statements.

12.2. Identify voltmeter indications of open- and short-circuit conditions, by selecting statements.

12.3. Identify ammeter indications of open- and short-circuit conditions, by selecting statements.

LESSON TOPIC 4.13.1. TROUBLESHOOTING A SERIES D-C CIRCUIT.

Estimated contact hours allotted lesson topic: learning center, 6.0 hours.

TERMINAL OBJECTIVE

Supported entirely by this lesson topic.

When the student completes this course, he will be able to:

13.0. Locate opens and shorts in a d-c series circuit by measuring normal circuit voltage, resistance, and current and comparing these measurements with abnormal circuit values. Given a Simpson 260-5P, measure normal circuit conditions and record the values. Then take measurements in the same circuit with faults installed. All measurements are within the tolerance of the meter.

MODULE 5.0. PARALLEL CIRCUITS.

Estimated contact hours allotted this module: learning center, 9.0 hours.

TERMINAL OBJECTIVE

Supported entirely by this module.

When the student completes this course, he will be able to:

14.0. Determine normal circuit conditions in a d-c parallel circuit by theoretical analysis and the application of rules and laws concerning voltage, resistance, and current relationships in multielement d-c parallel circuits by selecting statements concerning these laws. Standard is 100 percent.

15.0. Determine the effects on d-c parallel circuits of opens, shorts, and changing loads by theoretical analysis and the application of concepts concerning voltage, resistance, and current in a multielement d-c parallel circuit. Standard is 100 percent.

16.0. Use the Simpson 260-5P to measure values of voltage, current, and resistance in a parallel circuit containing indicated shorts and opens. Given a Simpson 260-5P and a test circuit with at least three components, locate shorts and opens. Standards are within the limitations of the meter.

17.0. Locate opens and shorts in d-c parallel circuits by measuring normal circuit voltage, resistance, and current and comparing these measurements with abnormal circuit values. Given a Simpson 260-5P, measure normal circuit conditions and record the values. Then take measurements in the same circuit with faults installed. Standards are within the limitations of the meter.

LESSON TOPIC 5.14.1. VOLTAGE AND CURRENT IN PARALLEL CIRCUITS.

Estimated contact hours allotted lesson topic: learning center, 1.0 hour.

TERMINAL OBJECTIVE

Supported partially by this lesson topic and by lesson topic 5.14.2.

When the student completes this course, he will be able to:

14.0. Determine normal circuit conditions in a d-c parallel circuit by theoretical analysis and the application of rules and laws concerning voltage, resistance, and current relationships in multielement d-c parallel circuits by selecting statements concerning these laws. Standard is 100 percent.

ENABLING OBJECTIVES

Supported entirely by this lesson topic.

When the student completes this lesson topic, he will be able to:

14.1. SOLVE for total current in a d-c parallel circuit. Given a schematic diagram and values of branch currents, select the total current. Standard is 100 percent.

14.2. IDENTIFY the relationships between the source voltage and the voltage drop across each branch of a parallel circuit. Given a schematic diagram and component values, select the branch voltage. Standard is 100 percent.

14.4. SOLVE for total current in a d-c parallel circuit. Given a schematic diagram and the values of voltage and resistance, select the total current. Standard is 100 percent.

14.5. SOLVE for the value of the power dissipated in a d-c parallel circuit. Given values of current, voltage, and resistance, determine total power, using two values. Standard is 100 percent.

LESSON TOPIC 5.14.2. EQUIVALENT RESISTANCE.

Estimated contact hours allotted lesson topic: learning center, 1.0 hour.

TERMINAL OBJECTIVE

Supported partially by this lesson topic and by lesson topic 5.14.1.

When the student completes this course, he will be able to:

14.0. Determine normal circuit conditions in a d-c parallel circuit by theoretical analysis and the application of rules and laws concerning voltage, resistance, and current relationships in multielement d-c parallel circuits by selecting statements concerning these laws. Standard is 100 percent.

ENABLING OBJECTIVES

Supported entirely by this lesson topic.

When the student completes this lesson topic, he will be able to:

14.3. COMPARE equivalent resistance with branch resistance by selecting a statement. Standard is 100 percent.

14.3.1. SOLVE for R_{eq}, using the product-over-the-sum method, given a schematic and component values. Standard is 100 percent.

14.3.2. SOLVE for R_{eq} when all the branch resistances are equal, given a schematic and component values. Standard is 100 percent.

14.3.3. SOLVE for R_{eq}, using the reciprocal method, given a schematic and component values. Standard is 100 percent.

LESSON TOPIC 5.15.1. VARIATIONAL ANALYSES OF D-C PARALLEL CIRCUITS.

Estimated contact hours allotted lesson topic: learning center, 2.0 hours.

TERMINAL OBJECTIVE

Supported entirely by this lesson topic.

When the student completes this course, he will be able to:

15.0. Determine the effects on d-c parallel circuits of opens, shorts, and changing loads by theoretical analysis and the application of concepts concerning voltage, resistance, and current in a multielement d-c parallel circuit. Standard is 100 percent.

ENABLING OBJECTIVES

Supported entirely by this lesson topic.

When the student completes this lesson topic, he will be able to:

15.1. DETERMINE conditions in a circuit when the applied voltage is varied. Given values of voltage, current, and resistance in a parallel circuit containing two branches, select a table indicating the correct conditions. Standard is 100 percent.

15.1.1. IDENTIFY the effect on current in a circuit when the voltage is increased and the resistance remains the same. Given values of voltage, current, and resistance in a parallel circuit containing at least two branches, select a statement concerning the total current. Standard is 100 percent.

15.1.2. IDENTIFY the effect on current in a circuit when the voltage is decreased and the resistance remains the same. Given values of voltage, current, and resistance in a parallel circuit containing at least two branches, select a statement concerning the total current. Standard is 100 percent.

15.2. DETERMINE the conditions in a circuit when resistance is varied. Given values of voltage, current, and resistance in a parallel circuit containing at least two branches, select a table indicating the correct conditions. Standard is 100 percent.

15.2.1. DETERMINE the effect on current in a circuit when the resistance is increased and voltage remains the same. Given values of voltage, current, and resistance in a parallel circuit containing at least two branches, select a statement concerning the total current. Standard is 100 percent.

15.2.2. DETERMINE the effect on current in a circuit when the resistance is decreased and voltage remains the same. Given values of voltage, current, and resistance in a parallel circuit containing at least two branches, select a statement concerning the total current. Standard is 100 percent.

15.3. IDENTIFY the conditions in a parallel circuit when the resistance of one branch is changed. Given a schematic showing resistor and ammeter connections in a parallel circuit containing at least two branches, select the conditions that exist when the change occurs. Standard is 100 percent.

15.4. DETERMINE which resistor(s) in a circuit will overheat first if all resistors have the same wattage rating. Given values of voltage, current, and resistance in a parallel circuit containing at least two branches, select the resistor(s). Standard is 100 percent.

15.5. DETERMINE conditions in circuits when opens and shorts are inserted. Given values of voltage, current, and resistance in parallel circuits containing at least two branches, select tables indicating the correct conditions. Standard is 100 percent.

LESSON TOPIC 5.16.1. MEASURING VALUES IN A D-C PARALLEL CIRCUIT.

Estimated contact hours allotted lesson topic: learning center, 2.5 hours.

TERMINAL OBJECTIVE

Supported entirely by this lesson topic.

When the student completes this course, he will be able to:

16.0. Use the Simpson 260-5P to measure values of voltage, current, and resistance in a parallel circuit containing indicated shorts and opens. Given a Simpson 260-5P and a test circuit with at least three components, locate shorts and opens. Standards are within the limitations of the meter.

LESSON TOPIC 5.17.1. TROUBLESHOOTING A D-C PARALLEL CIRCUIT.

Estimated contact hours allotted lesson topic: learning center, 2.5 hours.

TERMINAL OBJECTIVE

Supported entirely by this lesson topic.

When the student completes this course, he will be able to:

17.0. Locate opens and shorts in d-c parallel circuits by measuring normal circuit voltage, resistance, and current and comparing these measurements with abnormal circuit values. Given a Simpson 260-5P, measure normal circuit conditions and record the values. Then take measurements in the same circuit with faults installed. Standards are within the limitations of the meter.

MODULE 6.0. COMBINATION D-C CIRCUITS.

Estimated contact hours allotted this module: learning center, 8.0 hours.

TERMINAL OBJECTIVES

Supported entirely by this module.

When the student completes this course, he will be able to:

18.0. Determine normal circuit conditions in a d-c combination circuit by theoretical analysis and the application of rules and laws concerning voltage, resistance, and current relationships in a multielement d-c combination circuit. Standard is 100 percent.

19.0. Determine the effects on combination d-c circuits of opens, shorts, and changing loads, by theoretical analysis and the application of concepts concerning voltage, resistance, and current in a multielement combination d-c circuit. Standard is 100 percent.

20.0. Measure circuit values of voltage, current, and resistance in a combination circuit containing indicated shorts and opens, given a Simpson 260-5P and a test circuit of at least three components. Standards are within the limitations of the meter.

21.0. Locate opens and shorts in combination d-c circuits by measuring normal circuit voltage, resistance, and current and comparing these measurements with abnormal circuit values. Given a Simpson 260-5P, measure normal circuit conditions and record the values. Then take measurements in the same circuit with faults installed. Standards are within limitations of the meter.

LESSON TOPIC 6.18.1. VOLTAGE, CURRENT, AND RESISTANCE IN D-C COMBINATION CIRCUITS.

Estimated contact hours allotted lesson topic: learning center, 2.0 hours.

TERMINAL OBJECTIVE

Supported entirely by this lesson topic.

When the student completes this course, he will be able to:

18.0. Determine normal circuit conditions in a d-c combination circuit by theoretical analyis and the application of rules and laws concerning voltage, resistance, and current relationships in a multielement d-c combination circuit. Standard is 100 percent.

ENABLING OBJECTIVES

Supported entirely by this lesson topic.

When the student completes this lesson topic, he will be able to:

18.1. IDENTIFY the current path in a d-c combination circuit by selecting the current path on a schematic. Standard is 100 percent.

18.2. SOLVE for the branch currents in a d-c combination series-parallel circuit, given schematics and values. Standard is 100 percent.

18.3. SOLVE for total current in a d-c combination series-parallel circuit, given schematics and values. Standard is 100 percent.

18.4. SOLVE for total power in a d-c combination series-parallel circuit, given schematics and values. Standard is 100 percent.

18.5. SOLVE for the total resistance of a d-c combination series-parallel circuit, given schamatics and values. Standard is 100 percent.

LESSON TOPIC 6.19.1. VARIATIONAL ANALYSES OF COMBINATION CIRCUITS

Estimated contact hours allotted lesson topic: learning center, 1.5 hours.

TERMINAL OBJECTIVE

Supported entirely by this lesson topic.

When the student completes this course, he will be able to:

19.0. Determine the effects on combination d-c circuits of opens, shorts, and changing loads, by theoretical analysis and the application of concepts concerning voltage, resistance, and current in a multielement combination d-c circuit. Standard is 100 percent.

ENABLING OBJECTIVES

When the student completes this lesson topic, he will be able to:

19.1. IDENTIFY the probable cause of a change in current in a circuit. Given values of voltage, current, and resistance in a combination circuit containing at least three resistors in two branches, complete a statement indicating the correct conditions. Standard is 100 percent.

19.1.1. DETERMINE conditions in a circuit when the applied voltage is varied. Given values of voltage, current, and resistance in a combination circuit containing at least three resistors in two branches, complete a table indicating correct conditions. Standard is 100 percent.

19.1.2. IDENTIFY the effect on current in a circuit when the voltage is increased and the resistance remains the same. Given values of voltage, current, and resistance in a combination circuit containing at least three resistors in the branches, select a table indicating the correct conditions. Standard is 100 percent.

19.1.3. IDENTIFY the effect on current in a circuit when the voltage is decreased and the resistance remains the same. Given values of voltage, current, and resistance in a combination circuit containing at least three resistors in two branches, select a table indicating the correct conditions. Standard is 100 percent.

19.1.4. DETERMINE the conditions in a circuit when circuit resistance is varied. Given values of voltage, current, and resistance in a combination circuit containing at least three resistors in two branches, select a table indicating the correct conditions. Standard is 100 percent.

19.1.5. DETERMINE the effect on current in a circuit when the resistance is increased and voltage remains the same. Given values of voltage, current, and resistance in a combination circuit containing at least three resistors in two branches, select a table indicating the correct conditions. Standard is 100 percent.

19.1.6. DETERMINE the effect on current in a circuit when the resistance is decreased and voltage remains the same. Given values of voltage, current, and resistance in a combination circuit containing at least three resistors in two branches, select a table indicating the correct conditions. Standard is 100 percent.

19.1.7. DETERMINE which resistor in a circuit will overheat if all resistors have the same wattage rating. Given values of voltage, current, and resistance in a combination circuit containing at least three resistors in two branches, select the resistor. Standard is 100 percent.

19.1.8. DETERMINE conditions in a circuit when a short is inserted. Given values of voltage, current, and resistance in a combination circuit containing at least three resistors in two branches, select a statement describing the correct conditions. Standard is 100 percent.

19.2. DETERMINE conditions in a circuit when an open is inserted. Given values of voltage, current, and resistance in a combination circuit containing at least three resistors in two branches, select a statement describing the correct conditions. Standard is 100 percent.

19.3. ANALYZE an incorrect circuit value to determine a possible cause. Given a complex circuit containing at least three resistors in two branches, select the component(s) that could cause the problem. Standard is 100 percent.

LESSON TOPIC 6.20.1. TROUBLESHOOTING AND MEASURING VALUES IN D-C COMBINATION CIRCUITS.

Estimated contact hours allotted lesson topic: learning center, 2.0 hours.

TERMINAL OBJECTIVES

Supported entirely by this lesson topic.

When the student completes this course, he will be able to:

20.0. Measure circuit values of voltage, current, and resistance in a combination circuit containing indicated shorts and opens, given a Simpson 260-5P and a test circuit of at least three components. Standards are within the limitations of the meter.

21.0. Locate opens and shorts in combination d-c circuits by measuring normal circuit voltage, resistance, and current and comparing these measurements with abnormal circuit values. Given a Simpson 260-5P, measure normal circuit conditions and record the values. Then take measurements in the same circuit with faults installed. Standards are within limitations of the meter.

MODULE 7.0. SPECIAL D-C CIRCUITS

Estimated contact hours allotted this module: learning center, 4.0 hours.

TERMINAL OBJECTIVES

Supported entirely by this module.

When the student completes this course, he will be able to:

22.0. Determine voltage values and polarities in a series voltage-reference network having a single source. Given a schematic diagram of one power source, four resistors in series, and a ground between any two resistors, calculate the values and identify the polarities. Standard is 100 percent.

23.0. Determine circuit conditions in a voltage-divider network with multiple loads. Given schematic diagrams with source voltage and resistance values, solve for total current, load currents, load voltages, and polarities. Standard is 100 percent.

LESSON TOPIC 7.22.1. VOLTAGE REFERENCES.

Estimated contact hours allotted lesson topic: learning center, 1.5 hours.

TERMINAL OBJECTIVE

Supported entirely by this lesson topic.

When the student completes this course, he will be able to:

22.0. Determine voltage values and polarities in a series voltage-reference network having a single source. Given a schematic diagram of one power source, four resistors in series, and a ground between any two resistors, calculate the values and identify the polarities. Standard is 100 percent.

ENABLING OBJECTIVES

Supported entirely by this lesson topic.

When the student completes this lesson topic, he will be able to:

22.1. DEFINE *reference point* as related to a voltage-reference network, by selecting statements about the terms *common*, *ground*, and *arbitrary point*. Standard is 100 percent.

22.5. IDENTIFY the polarities of various points in a voltage-reference network with respect to a reference other than ground. Given schematics with values and source polarities, solve for polarities in terms of specified references. Standard is 100 percent.

22.3. IDENTIFY the polarities of various points in a voltage-reference network with respect to ground reference. Given schematics with values and source polarities, solve for polarities in terms of specified references. Standard is 100 percent.

22.4. SOLVE for the values of voltage at various points in a voltage-reference network with respect to a reference other than ground. Given schematics with values and source polarities, solve for voltage values in terms of specified references. Standard is 100 percent.

22.2. SOLVE for the values of voltage at various points in a voltage-reference network with respect to ground reference. Given schematics with values and source polarities, solve for voltage values in terms of specified references. Standard is 100 percent.

LESSON TOPIC 7.23.1. VOLTAGE DIVIDERS.

Estimated contact hours allotted lesson topic: learning center, 2.5 hours.

TERMINAL OBJECTIVE

Supported entirely by this lesson topic.

When the student completes this course, he will be able to:

23.0. Determine circuit conditions in a voltage-divider network with multiple loads. Given schematic diagrams with source voltage and resistance values, solve for total current, load currents, load voltages, and polarities. Standard is 100 percent.

ENABLING OBJECTIVES

Supported entirely by this lesson topic.

When the student completes this lesson topic, he will be able to:

23.1. SOLVE for the values of current in a voltage-divider network with multiple loads. Given a schematic diagram with source voltage and resistance values, calculate the current flow through all components. Standard is 100 percent.

23.2. SOLVE for the values of voltage drops in a voltage-divider network with multiple loads. Given a schematic diagram with source voltage and resistance values, calculate voltage values across all components. Standard is 100 percent.

23.3. DETERMINE the effects on voltage drops in a voltage-divider network with multiple loads when one of the loads opens. Given a schematic diagram with source voltage and resistance values, calculate the change in voltage drops. Standard is 100 percent.

MODULE 8.0. INTRODUCTION TO A-C TEST EQUIPMENT.

Estimated contact hours allotted this module: learning center, 15.0 hours.

TERMINAL OBJECTIVE

Supported entirely by this module.

When the student completes this course, he will be able to:

24.0. Use the EICO 377 signal generator to generate sine wave at various frequencies and amplitudes, while monitoring the waves with the WO-33A or WO-33B oscilloscope and measuring the values with the WV-77E vacuum-tube voltmeter (VTVM). Standard is within the tolerance of the meter.

25.0. Compare the a-c peak-to-peak voltage of a sine wave measured with the WO-33A or WO-33B oscilloscope with the a-c effective voltage of a sine wave measured with the WV-77E vacuum-tube voltmeter and record the values. Accuracy must be within 10 percent of the indicated values.

LESSON TOPIC 8.25.1. BASIC ALTERNATOR OPERATION.

Estimated contact hours allotted lesson topic: learning center, 2.0 hours.

TERMINAL OBJECTIVE

Supported partially by this lesson topic and by lesson topic 8.25.2.

When the student completes this course, he will be able to:

25.0. Compare the a-c peak-to-peak voltage of a sine wave measured with the WO-33A or WO-33B oscilloscope with the a-c effective voltage of a sine wave measured with the WV-77E vacuum-tube voltmeter and record the values. Accuracy must be within 10 percent of the indicated values.

ENABLING OBJECTIVES

Supported entirely by this lesson topic.

When the student completes this lesson topic, he will be able to:

25.2. ANALYZE the illustration of a sine wave to determine characteristics and frequency by matching parts of the sine wave with identifying terms. Standard is 100 percent.

25.2.1. IDENTIFY the factors required to develop a-c voltage by electromagnetic induction, given an illustration of a simple generator, by selecting statements that correctly identify the factors in the illustration. Standard is 100 percent.

25.2.2. IDENTIFY the instantaneous points on a sine wave, which corresponds to the degree and direction of rotation of a single loop rotating through a magnetic field, by matching points of rotation with points on the sine wave. Standard is 100 percent.

25.2.2.1. IDENTIFY the position of a conductor in a magnetic field when the induced voltage is maximum, by selecting an illustration. Standard is 100 percent.

25.2.2.2. IDENTIFY the factors that determine the frequency of an alternator, by selecting statements. Standard is 100 percent.

25.2.2.3. DETERMINE the output frequency of an alternator, given a description of its construction and its speed of rotation, by selecting values. Standard is 100 percent.

25.2.2.4 SOLVE for the amount of time for one cycle of the output of an alternator, given the value of frequency. Standard is 100 percent.

25.1. IDENTIFY the values of a peak-to-peak voltage waveform by selecting the values on an illustration. Standard is 100 percent.

25.1.1. IDENTIFY the effective voltage of an a-c sine wave by selecting a lettered arrow indicating its value on the sine wave. Standard is 100 percent.

25.1.2. COMPUTE effective voltage values, given values of peak-to-peak voltage. Standard is 100 percent.

25.1.3. COMPUTE peak-to-peak voltage values, given values of effective voltage. Standard is 100 percent.

LESSON TOPIC 8.24.1. THE RCA WO-33A OSCILLOSCOPE AND THE RCA WO-33B OSCILLOSCOPE.

Estimated contact hours allotted lesson topic: learning center, 2.5 hours.

TERMINAL OBJECTIVE

Supported partially by this lesson topic and by lesson topics 8.24.2, 8.24.3, and 8.24.4.

When the student completes this course, he will be able to:

24.0. Use the EICO 377 signal generator to generate sine waves at various frequencies and amplitudes, while monitoring the waves with the WO-33A or WO-33B oscilloscope and measuring the values with the WV-77E vacuum-tube voltmeter (VTVM). Standard is within the tolerance of the meter.

ENABLING OBJECTIVES

Supported entirely by this lesson topic.

When the student completes this lesson topic, he will be abl to:

24.3.1. IDENTIFY the three primary uses of an oscilloscope by selecting correct statements. Standard is 100 percent.

24.3.2. IDENTIFY the hazards peculiar to oscilloscopes, for which adequate safety precautions must be observed, by selecting correct statements about the cathode-ray tube's vacuum and coating. Standard is 100 percent.

24.3.4. IDENTIFY the functions of the controls and jacks on the WO-33A or WO-33B oscilloscope by matching the names with their functions. Standard is 100 percent.

24.3.5. IDENTIFY the scales on the oscilloscope screen by selecting descriptions of the scales. Standard is 100 percent.

24.3.6. CALIBRATE the WO-33A or WO-33B oscilloscope, following given instructions. Standard is 100 percent.

LESSON TOPIC 8.24.2. THE EICO 377 AUDIO SIGNAL GENERATOR.

Estimated contact hours allotted lesson topic: learning center, 2.5 hours.

TERMINAL OBJECTIVE

Supported partially by this lesson topic and by lesson topics 8.24.1, 8.24.3, and 8.24.4.

When the student completes this course, he will be able to:

24.0. Use the EICO 377 signal generator to generate sine waves at various frequencies and amplitudes, while monitoring the waves with the WO-33A or WO-33B oscilloscope and measuring the values with the WV-77E vacuum-tube voltmeter (VTVM). Standard is within the tolerance of the meter.

ENABLING OBJECTIVES

Supported entirely by this lesson topic.

When the student completes this lesson topic, he will be able to:

24.2. OPERATE the EICO signal generator to produce an a-c sine wave at a given frequency and voltage and observe the sine wave with the WO-33A or WO-33B oscilloscope. Observe proper safety precautions.

24.2.2. IDENTIFY the purposes of the controls and terminals on the EICO 377 signal generator by selecting statements. Standard is 100 percent.

LESSON TOPIC 8.24.3. THE RCA WV-77E VACUUM-TUBE VOLTMETER.

Estimated contact hours allotted lesson topic: learning center, 2.5 hours.

TERMINAL OBJECTIVE

Supported partially by this lesson topic and by lesson topics 8.24.1, 8.24.2, and 8.24.4.

When the student completes this course, he will be able to:

24.0. Use the EICO 377 signal generator to generate sine waves at various frequencies and amplitudes, while monitoring the waves with the WO-33A or WO-33B oscilloscope and measuring the values with the WV-77E vacuum-tube voltmeter (VTVM). Standard is within the tolerance of the meter.

24.1.1. IDENTIFY the principal advantage of using the VTVM, rather than the VOM, by selecting a statement. Standard is 100 percent.

24.1.2. IDENTIFY the functions of the controls and terminals of the WV-77E by selecting statements. Standard is 100 percent.

24.1.3. IDENTIFY the section of the scale on the WV-77E that should be used for the most accurate voltage readout by selecting the correct pointer position on an illustration. Standard is 100 percent.

24.1.4. IDENTIFY the section of the scale on the WV-77E that should be used for the most accurate resistance readout by selecting the correct pointer position on an illustration. Standard is 100 percent.

24.1.5. CALIBRATE the WV-77E VTVM, given specific instructions. Standard is 100 percent.

24.2.3. USE the RCA WO-33A or WO-33B oscilloscope to observe and measure periodic a-c waveforms, while observing proper safety precautions.

LESSON TOPIC 8.24.4. USE OF A-C TEST EQUIPMENT.

Estimated contact hours allotted lesson topic: learning center, 2.5 hours.

TERMINAL OBJECTIVE

Supported partially by this lesson topic and by lesson topics 8.24.1, 8.24.2, and 8.24.3.

When the student completes this course, he will be able to:

24.0. Use the EICO 377 signal generator to generate sine waves at various frequencies and amplitudes, while monitoring the waves with the WO-33A or WO-33B oscilloscope and measuring the values with the WV-77E vacuum-tube voltmeter (VTVM). Standard is within the tolerance of the meter.

LESSON TOPIC 8.25.2. FUNCTIONAL ANALYSIS OF SINE WAVE VALUES.

Estimated contact hours allotted lesson topic: learning center, 2.0 hours.

TERMINAL OBJECTIVE

Supported partially by this lesson topic and by lesson topic 8.25.1.

When the student completes this course, he will be able to:

25.0. Compare the a-c peak-to-peak voltage of a sine wave measured with the WO-33A or WO-33B oscilloscope with the a-c effective voltage of a sine wave measured with the WV-77E vacuum-tube voltmeter and record the values. Accuracy must be within 10 percent of the indicated values.

MODULE 9.0. INTRODUCTION TO INDUCTORS.

Estimated contact hours allotted this module: learning center 2.0 hours.

TERMINAL OBJECTIVE

Supported entirely by this module.

When the student completes this course, he will be able to:

26.0. Determine the effects on inductive reactance and circuit current when the inductance and the applied frequency are varied, given a schematic diagram and component values, by selecting a table. Standard is 100 percent.

LESSON TOPIC 9.26.1. INDUCTORS.

Estimated contact hours allotted lesson topic: learning center, 0.5 hour.

TERMINAL OBJECTIVE

Supported partially by this lesson topic and by lesson topics 9.26.2, 9.26.3, and 9.26.4.

When the student completes this course, he will be able to:

26.0. Determine the effects on inductive reactance and circuit current when the inductance and the applied frequency are varied, given a schematic diagram and component values, by selecting a table. Standard is 100 percent.

ENABLING OBJECTIVES

Supported entirely by this lesson topic.

26.1.1. DEFINE an *inductor* in terms of its physical construction by selecting a statement. Standard is 100 percent.

26.1.3. IDENTIFY the unit of measurement of inductance by selecting the unit. Standard is 100 percent.

26.1.2. IDENTIFY the schematic symbol for an air-core inductor by selecting the symbol. Standard is 100 percent.

26.1. DETERMINE the effects on inductance of varying each of the physical factors of an inductor (number of turns, cross-sectional area, and spacing of the coil) by selecting statements. Standard is 100 percent.

LESSON TOPIC 9.26.2. SOLVING FOR INDUCTANCE IN CIRCUITS.

Estimated contact hours allotted lesson topic: learning center, 0.5 hour.

TERMINAL OBJECTIVE

Supported partially by this lesson topic and by lesson topics 9.26.1, 9.26.3, and 9.26.4.

When the student completes this course, he will be able to:

26.0. Determine the effects on inductive reactance and circuit current when the inductance and the applied frequency are varied, given a schematic diagram and component values, by selecting a table. Standard is 100 percent.

ENABLING OBJECTIVES

Supported entirely by this lesson topic.

When the student completes this lesson topic, he will be able to:

26.2.1. IDENTIFY the formula used to solve for total inductance when two or more inductors are connected in series, by selecting the correct formula. Standard is 100 percent.

26.2.2. IDENTIFY the formulas used to solve for total inductance when two or more inductors are connected in parallel, by selecting the correct formula. Standard is 100 percent.

26.2.1.1. SOLVE for the total inductance of three inductors connected in series, given a schematic diagram and component values. Standard is 100 percent.

26.2.2.1. SOLVE for the total inductance of three inductors connected in parallel, given a schematic diagram and component values. Standard is 100 percent.

26.2.2.2. SOLVE for the total inductance in a circuit having one inductor in series with two inductors in parallel, given a schematic diagram and component values. Standard is 100 percent.

26.2. COMPUTE total inductance of series-connected, parallel-connected, and series-parallel-connected inductors, given schematic diagrams and component values. Standard is 100 percent.

LESSON TOPIC 9.26.3. THE RELATIONSHIP OF VOLTAGE AND CURRENT IN INDUCTIVE-REACTIVE A-C CIRCUITS.

Estimated contact hours allotted lesson topic: learning center, 0.5 hour.

TERMINAL OBJECTIVE

Supported partially by this lesson topic and by lesson topic 9.26.1, 9.26.2, and 9.26.4.

When the student completes this course, he will be able to:

26.0. Determine the effects on inductive reactance and circuit current when the inductance and the applied frequency are varied, given a schematic diagram and component values, by selecting a table. Standard is 100 percent.

ENABLING OBJECTIVES

Supported entirely by this lesson topic.

When the student completes this lesson topic, he will be able to:

26.4.1. DEFINE *true power, reactive power*, and *apparent power* in an inductive-reactive a-c circuit by selecting the correct statements. Standard is 100 percent.

26.4. SELECT a graph that correctly represents the phase relationship between current and voltage in an inductive circuit. Standard is 100 percent.

LESSON TOPIC 9.26.4. INDUCTIVE REACTANCE.

Estimated contact hours allotted lesson topic: learning center, 0.5 hour.

TERMINAL OBJECTIVE

Supported partially by this lesson topic and by lesson topics 9.26.1, 9.26.2, and 9.26.3.

When the student completes this course, he will be able to:

26.0. Determine the effects on inductive reactance and circuit current when the inductance and the applied frequency are varied, given a schematic diagram and component values, by selecting a table. Standard is 100 percent.

ENABLING OBJECTIVES

Supported entirely by this lesson topic.

When the student completes this lesson topic, he will be able to:

26.3.1. DEFINE *inductive reactance* and its unit of measurement by selecting statements. Standard is 100 percent.

26.3. SOLVE for inductive reactance, using the formula $X_L = 2\pi fL$ given a schematic diagram and component values. Standard is 100 percent.

MODULE 10.0. TRANSFORMER IDENTIFICATION AND OPERATION.

Estimated contact hours allotted this module: learning center, 4.0 hours.

TERMINAL OBJECTIVE

Supported entirely by this module.

When the student completes this course, he will be able to:

27.0. Measure and record primary and secondary voltages and currents in a transformer with loads of various values in order to determine the effects of load size on primary current. Observe personal safety precautions and follow proper equipment protection procedures. Standard is 100 percent.

LESSON TOPIC 10.27.1. TRANSFORMER IDENTIFICATION AND OPERATION.

Estimated contact hours allotted lesson topic: learning center, 1.0 hour.

TERMINAL OBJECTIVE

Supported partially by this lesson topic and by lesson topics 10.27.2 and 10.27.3.

When the student completes this course, he will be able to:

27.0. Measure and record primary and secondary voltages and currents in a transformer with loads of various values in order to determine the effects of load size on primary current. Observe personal safety precautions and follow proper equipment protection procedures. Standard is 100 percent.

ENABLING OBJECTIVES

Supported entirely by this lesson topic.

When the student completes this lesson topic, he will be able to:

27.6.3. MATCH transformers with their schematic symbols. Standard is 100 percent.

27.6.4. DEFINE the different transformer core materials by matching the types of cores with their applications. Standard is 100 percent.

27.7. IDENTIFY the factors that determine a transformer's voltage-, current-, and power-handling capabilities, by matching the transformer capabilities with the factor(s) on which they depend. Standard is 100 percent.

27.6. IDENTIFY the characteristics that make it possible for a transformer to transfer power, by selecting statements. Standard is 100 percent.

27.6.1. IDENTIFY the factor that causes induction to take place in a transformer, by selecting statements. Standard is 100 percent.

27.6.2. SELECT, from a list, the factors that affect the transfer of energy in a transformer.

LESSON TOPIC 10.27.2. OPERATIONAL ANALYSES OF TRANSFORMERS.

Estimated contact hours allotted lesson topic: learning center, 1.0 hour.

TERMINAL OBJECTIVE

Supported partially by this lesson topic and by lesson topics 10.27.1 and 10.27.3.

When the student completes this course, he will be able to:

27.0. Measure and record primary and secondary voltages and currents in a transformer with loads of various values in order to determine the effects of load size on primary current. Observe personal safety precautions and follow proper equipment protection procedures. Standard is 100 percent.

ENABLING OBJECTIVES

Supported entirely by this lesson topic.

When the student completes this lesson topic, he will be able to:

27.5.2. CALCULATE turns ratios, using the formula $\frac{N_p}{N_s} = \frac{E_p}{E_s}$.

27.5.1. CALCULATE the primary and secondary powers, using measured values of current and voltage and the formula $P = IE$.

27.5.3. SOLVE for the percent of efficiency, using the formula percent of efficiency $= 100 \times \frac{P_{out}}{P_{in}}$.

27.3.1. CALCULATE the primary impedance, using the formula $Z_p = \frac{E_p}{I_p}$.

LESSON TOPIC 10.27.3. OPERATIONAL ANALYSES OF TRANSFORMERS.

Estimated contact hours allotted lesson topic: learning center, 2.0 hours.

TERMINAL OBJECTIVE

Supported partially by this lesson topic and by lesson topics 10.27.1 and 10.27.2.

When the student completes this course, he will be able to:

27.0. Measure and record primary and secondary voltages and currents in a transformer with loads or various values in order to determine the effects of load size on primary current. Observe personal safety precautions and follow proper equipment protection procedures. Standard is 100 percent.

ENABLING OBJECTIVES

Supported entirely by this lesson topic.

When the student completes this lesson topic, he will be able to:

27.2. MEASURE and record the primary voltage, using a multimeter or a VTVM, in accordance with prescribed safety precautions. Observe personal safety precautions and follow proper equipment protection procedures.

27.4. MEASURE and record the secondary voltages, using the multimeter or a VTVM. Observe personal safety precautions and follow proper equipment protection procedures.

27.3. MEASURE and record the primary current, using an installed current measuring device. Observe personal safety precautions and follow proper equipment protection procedures.

27.5. MEASURE and record the secondary currents, using installed current measuring devices. Observe personal safety precautions and follow proper equipment protection procedures.

MODULE 11.0. INTRODUCTION TO CAPACITORS AND RC/RL TIME CONSTANTS.

Estimated contact hours allotted this module: learning center, 14.0 hours.

TERMINAL OBJECTIVE

Supported entirely by this module.

When the student completes this course, he will be able to:

28.0. Determine the effects on capacitive reactance and circuit current when capacitance and the applied frequency are varied, given a schematic diagram and component values, by selecting a table. Standard is 100 percent.

29.0. Analyze an RC circuit during charge and discharge, by selecting circuit values. Standard is 100 percent.

30.0. Analyze an RL circuit during charge and discharge, by selecting circuit values. Standard is 100 percent.

LESSON TOPIC 11.28.1. CAPACITORS.

Estimated contact hours allotted lesson topic: learning center, 1.0 hour.

TERMINAL OBJECTIVE

Supported partially by this lesson topic and by lesson topics 11.28.2, 11.28.3, and 11.28.4.

When the student completes this course, he will be able to:

28.0. Determine the effects on capacitive reactance and circuit current when capacitance and the applied frequency are varied, given a schematic diagram and component values, by selecting a table. Standard is 100 percent.

ENABLING OBJECTIVES

Supported entirely by this lesson topic.

When the student completes this lesson topic, he will be able to:

28.1.1. DEFINE a capacitor by selecting a statement. Standard is 100 percent.

28.1.2. IDENTIFY the schematic symbol for a capacitor by selecting the symbol. Standard is 100 percent.

28.5. IDENTIFY capacitor classifications by matching schematic symbols with their classifications. Standard is 100 percent.

28.2.3. IDENTIFY the unit of measurement of capacitance by selecting the unit. Standard is 100 percent.

28.5.1. IDENTIFY the different types of variable capacitors by selecting the types. Standard is 100 percent.

28.1. DETERMINE the effects on capacitance of varying each of the physical factors of a capacitor (area of plates and type of dielectric material), by selecting effects. Standard is 100 percent.

28.5.2. IDENTIFY a correctly installed electrolytic capacitor, given schematic diagrams, by selecting the correct diagram. Standard is 100 percent.

28.5.3. COMPARE the working volts d.c. of a capacitor, the a-c peak-to-peak, and a-c effective, by selecting statements. Standard is 100 percent.

28.5.4. CALCULATE the minimum safe value of the d-c working voltage for a capacitor, given a value of a-c voltage. Standard is 100 percent.

LESSON TOPIC 11.28.2. SOLVING CAPACITOR CIRCUITS.

Estimated contact hours allotted lesson topic: learning center, 1.0 hour.

TERMINAL OBJECTIVE

Supported partially by this lesson topic and by lesson topics 11.28.1, 11.28.3, and 11.28.4.

When the student completes this course, he will be able to:

28.0. Determine the effects on capacitive reactance and circuit current when capacitance and the applied frequency are varied, given a schematic diagram and component values, by selecting a table. Standard is 100 percent.

ENABLING OBJECTIVES

Supported entirely by this lesson topic.

When the student completes this lesson topic, he will be able to:

28.2.1. IDENTIFY the formula for computing total capacitance of capacitors in series, by selecting the correct formula. Standard is 100 percent.

28.2.1.1. SOLVE for total capacitance of three capacitors connected in series, given a schematic diagram and component values. Standard is 100 percent.

28.2.2. IDENTIFY the formula for computing total capacitance of capacitors in parallel, by selecting the correct formula. Standard is 100 percent.

28.2.2.1. SOLVE for total capacitance of three capacitors connected in parallel, given a schematic diagram and component values. Standard is 100 percent.

28.2. SOLVE for total capacitance of a circuit having one capacitor in series with two capacitors in parallel, given a schematic diagram and component values. Standard is 100 percent.

LESSON TOPIC 11.28.3. THE RELATIONSHIP OF VOLTAGE, CURRENT, AND POWER IN THE A-C CAPACITIVE CIRCUIT.

Estimated contact hours allotted lesson topic: learning center, 1.0 hour.

TERMINAL OBJECTIVE

Supported partially by this lesson topic and by lesson topics 11.28.1, 11.28.2, and 11.28.4.

When the student completes this course, he will be able to:

28.0. Determine the effects on capacitive reactance and circuit current when capacitance and the applied frequency are varied, given a schematic diagram and component values, by selecting a table. Standard is 100 percent.

ENABLING OBJECTIVES

Supported entirely by this lesson topic.

When the student completes this lesson topic, he will be able to:

28.4.1. DEFINE *true power*, *reactive power*, and *apparent power* in a capacitive-reactive a-c circuit, by selecting the definitions. Standard is 100 percent.

28.4. IDENTIFY the phase relationship of current, voltage, and power in a purely capacitive-reactive a-c circuit, by selecting a graph. Standard is 100 percent.

LESSON TOPIC 11.28.4. CAPACITIVE REACTANCE.

Estimated contact hours allotted lesson topic: learning center, 1.0 hour.

TERMINAL OBJECTIVE

Supported partially by this lesson topic and by lesson topics 11.28.1, 11.28.2, and 11.28.3.

When the student completes this course, he will be able to:

28.0. Determine the effects on capacitive reactance and circuit current when capacitance and the applied frequency are varied, given a schematic diagram and component values, by selecting a table. Standard is 100 percent.

ENABLING OBJECTIVES

Supported entirely by this lesson topic.

When the student completes this lesson topic, he will be able to:

28.3.1. DEFINE capacitive reactance and identify its unit of measurement by selecting correct answers from given lists. Standard is 100 percent.

28.3. SOLVE for the capacitive reactance of a given capacitor, using the formula $X_C = \frac{1}{2\pi fC}$. Standard is 100 percent.

LESSON TOPIC 11.29.1. RC TIME CONSTANT.

Estimated contact hours allotted lesson topic: learning center, 5.0 hours.

TERMINAL OBJECTIVE

Supported entirely by this lesson topic.

When the student completes this course, he will be able to:

29.0. Analyze an RC circuit during charge and discharge, by selecting circuit values. Standard is 100 percent.

ENABLING OBJECTIVES

Supported entirely by this lesson topic.

When the student completes this lesson topic, he will be able to:

29.3. DETERMINE RC time constants by using the Universal Time Constant Chart and selecting the value of time constants. Standard is 100 percent.

29.4. DETERMINE the effect on the RC time of varying the value of resistance, by selecting the effect. Standard is 100 percent.

29.5. DETERMINE the effect on the RC time of varying the value of capacitance, by selecting the effect. Standard is 100 percent.

29.2. ANALYZE the effect on an RC circuit of varying the values of components to change the RC time, by selecting TC values. Standard is 100 percent.

29.1. DETERMINE the values of circuit current and resistor voltage in a series RC circuit at a specific time, by selecting the values. Standard is 100 percent.

LESSON TOPIC 11.30.1. RL TIME CONSTANT.

Estimated contact hours allotted lesson topic: learning center, 4.0 hours.

TERMINAL OBJECTIVE

Supported entirely by this lesson topic.

When the student completes this course, he will be able to:

30.0. Analyze an RL circuit during charge and discharge, by selecting circuit values. Standard is 100 percent.

ENABLING OBJECTIVES

Supported entirely by this lesson topic.

When the student completes this lesson topic, he will be able to:

30.3. DETERMINE RL time constants, using the Universal Time Constant Chart, by selecting the values. Standard is 100 percent.

30.4. DETERMINE the effect on the RL time of varying the value of resistance, by selecting the effect. Standard is 100 percent.

30.5. DETERMINE the effect on the RL time of varying the value of inductance, by selecting the effect. Standard is 100 percent.

30.2. ANALYZE the effect on an RL circuit of varying the circuit's components to change the RL time, by selecting the value of the time constant. Standard is 100 percent.

30.1. DETERMINE the values of circuit current and resistor voltage in a series RL circuit at a specific time, by selecting the values. Standard is 100 percent.

MODULE 12.0. RL AND RC FILTERS.

Estimated contact hours allotted this module: learning center, 10.0 hours.

TERMINAL OBJECTIVES

Supported entirely by this module.

When the student completes this course, he will be able to:

31.0. Perform vector computations, using the sine, cosine, and tangent functions of a right triangle whose sides represent reactance, resistance, and impedance and a right triangle whose sides represent the voltage drop across the reactive component, the resistor, and the total voltage dropped across the two components. Standard is 100 percent.

32.0. Perform an operational analysis of a series RC filter and a series RL filter in order to determine the effects that changes in the reactive components have on the cutoff frequency, given test circuits, a signal generator, and a VTVM. Observe personal safety precautions and follow proper equipment protection procedures. Standard is within the tolerance of the test equipment.

LESSON TOPIC 12.31.1. VECTOR RELATIONSHIPS AND COMPUTATIONS.

Estimated contact hours allotted lesson topic: learning center, 3.0 hours.

TERMINAL OBJECTIVE

Supported entirely by this lesson topic.

When the student completes this course, he will be able to:

31.0. Perform vector computations, using the sine, cosine, and tangent functions of a right triangle whose sides represent reactance, resistance, and impedance and a right triangle whose sides represent the voltage drop across the reactive component, the resistor, and the total voltage dropped across the two components. Standard is 100 percent.

ENABLING OBJECTIVES

Supported entirely by this lesson topic.

When the student completes this lesson topic, he will be able to:

31.10. IDENTIFY the vector that represents the resistive component, by selecting a vector. Standard is 100 percent.

31.8. IDENTIFY the vector that represents an inductive component, by selecting a vector. Standard is 100 percent.

31.9. IDENTIFY the vector that represents a capacitive component, by selecting a vector. Standard is 100 percent.

31.11. IDENTIFY the vector that represents the resultant of reactive and resistive components, by selecting a vector. Standard is 100 percent.

31.2. IDENTIFY the leg of a right triangle that represents the resistive component, by selecting from an illustration. Standard is 100 percent.

31.1. IDENTIFY the leg of a right triangle that represents the reactive component, by selecting from an illustration. Standard is 100 percent.

31.3. IDENTIFY the leg of a right triangle that represents the impedance or applied voltage, by selecting from an illustration. Standard is 100 percent.

31.5. DEFINE total opposition in an a-c circuit by selecting a statement. Standard is 100 percent.

31.4. IDENTIFY how X_L and X_C are combined, by selecting an illustration. Standard is 100 percent.

31.6. IDENTIFY the hypotenuse, and the adjacent and opposite sides of a right triangle, by selecting from an illustration. Standard is 100 percent.

31.6.1. SOLVE for the sine of an angle, given the values of each side of a triangle. Standard is 100 percent.

31.6.2. SOLVE for the cosine of an angle, given the values of each side of a triangle. Standard is 100 percent.

31.6.3. SOLVE for the tangent of an angle, given the values of each side of a triangle. Standard is 100 percent.

31.6.4. USE a trigonometric function chart to find the sine, cosine, or tangent of a given angle. Standard is 100 percent.

31.6.5. SOLVE for the phase angle in a reactive circuit, given a reactive circuit with values. Standard is 100 percent.

31.6.6. DETERMINE the power factor in a series RLC circuit by completing the statement. Standard is 100 percent.

LESSON TOPIC 12.32.1. RC FILTER ACTION.

Estimated contact hours allotted lesson topic: learning center, 1.5 hours.

TERMINAL OBJECTIVE

Supported by this lesson topic and by lesson topics 12.32.2 and 12.32.3.

When the student completes this course, he will be able to:

32.0. Perform an operational analysis of a series RC filter and a series RL filter in order to determine the effects that changes in the reactive components have on the cutoff frequency, given test circuits, a signal generator, and a VTVM. Observe personal safety precautions and follow proper equipment protection procedures. Standard is within the tolerance of the test equipment.

ENABLING OBJECTIVES

When the student completes this lesson topic, he will be able to:

32.2.3. SELECT, from given diagrams, the schematic of a series RC low-pass filter. Standard is 100 percent.

32.2.2. SELECT, from given diagrams, the schematic of a series RC high-pass filter. Standard is 100 percent.

32.2.1. DETERMINE how filter action in a series RC circuit attenuates and passes different frequencies, by selecting statements. Standard is 100 percent.

32.2.12. SOLVE for the cutoff frequency of a series RC filter, given the values of resistance and capacitance. Standard is 100 percent.

32.2.4. DETERMINE the conditions in a series RC circuit when the applied frequency is increased and all other circuit values remain the same. Given values of frequency, capacitance, resistance, and voltage, select a table that indicates the correct conditions. Standard is 100 percent.

32.2.5. DETERMINE the conditions in a series RC circuit when the applied frequency is decreased and all other circuit values remain the same. Given values of frequency, capacitance. resistance, and voltage, select a table that indicates the correct conditions. Standard is 100 percent.

32.2.6. DETERMINE the conditions in a series RC circuit when the applied voltage is increased and all other circuit values remain the same. Given values of frequency, capacitance, and voltage, select a table that indicates the correct conditions. Standard is 100 percent.

32.2.7. DETERMINE the conditions in a series RC circuit when the applied voltage is decreased and all other circuit values remain the same. Given values of frequency, capacitance, resistance, and voltage, select a table that indicates the correct conditions. Standard is 100 percent.

32.2.8. DETERMINE the conditions in a series RC circuit when the capacitance is increased and all other circuit values remain the same. Given values of frequency, capacitance, resistance, and voltage, select a table that indicates the correct conditions. Standard is 100 percent.

32.2.9. DETERMINE the conditions in a series RC circuit when the capacitance is decreased and all other circuit values remain the same. Given values of frequency, capacitance, resistance, and voltage, select a table that indicates the correct conditions. Standard is 100 percent.

32.2.10. DETERMINE the conditions in a series RC circuit when the resistance is increased and all other circuit values remain the same. Given values of frequency, capacitance, resistance, and voltage, select a table that indicates the correct conditions. Standard is 100 percent.

32.2.11. DETERMINE the conditions in a series RC circuit when the resistance is decreased and all other circuit values remain the same. Given values of frequency, capacitance, resistance, and voltage, select a table that indicates the correct conditions. Standard is 100 percent.

LESSON TOPIC 12.32.2. RL FILTER ACTION

Estimated contact hours allotted lesson topic: learning center, 1.5 hours.

TERMINAL OBJECTIVE

Supported partially by this lesson topic and by lesson topics 12.32.1 and 12.32.3.

When the student completes this course, he will be able to:

32.0. Perform an operational analysis of a series RC filter and a series RL filter in order to determine the effects that changes in the reactive components have on the cutoff frequency, given test circuits, a signal generator, and a VTVM. Observe personal safety precautions and follow proper equipment protection procedures. Standard is within the tolerance of the test equipment.

ENABLING OBJECTIVES

Supported entirely by this lesson topic.

When the student completes this course, he will be able to:

32.4.2. SELECT, from given diagrams, the schematic of a series RL high-pass filter. Standard is 100 percent.

32.4.3. SELECT, from given diagrams, the schematic of a series RL low-pass filter. Standard is 100 percent.

32.4.1. DETERMINE how filter action in a series RL circuit attenuates and passes different frequencies, by selecting statements. Standard is 100 percent.

32.4.12. COMPUTE the cutoff frequency of a series RL filter, given the values of resistance and inductance. Standard is 100 percent.

32.4.4. DETERMINE the conditions in a series RL circuit when the applied frequency is increased and all other circuit values remain the same. Given values of frequency, inductance, resistance, and voltage, select a table that indicates the correct conditions. Standard is 100 percent.

32.4.5. DETERMINE the conditions in a series RL circuit when the applied frequency is decreased and all other circuit values remain the same. Given values of frequency, inductance, resistance, and voltage, select a table that indicates the correct conditions. Standard is 100 percent.

32.4.6. DETERMINE the conditions in a series RL circuit when the applied voltage is increased and all other circuit values remain the same. Given values of frequency, inductance, resistance, and voltage, select a table that indicates the correct conditions. Standard is 100 percent.

32.4.7. DETERMINE the conditions in a series RL circuit when the applied voltage is decreased and all other circuit values remain the same. Given values of frequency, inductance, resistance, and voltage, select a table that indicates the correct conditions. Standard is 100 percent.

32.4.8. DETERMINE the conditions in a series RL circuit when the inductance is increased and all other circuit values remain the same. Given values of frequency, inductance, resistance, and voltage, select a table that indicates the correct conditions. Standard is 100 percent.

32.4.9. DETERMINE the conditions in a series RL circuit when the inductance is decreased and all other circuit values remain the same. Given values of frequency, inductance, resistance, and voltage, select a table that indicates the correct conditions. Standard is 100 percent.

32.4.10. DETERMINE the conditions in a series RL circuit when the resistance is increased and all other circuit values remain the same. Given values of frequency, inductance, resistance, and voltage, select a table that indicates the correct conditions. Standard is 100 percent.

32.4.11. DETERMINE the conditions in a series RL circuit when the resistance is decreased and all other circuit values remain the same. Given values of frequency, inductance, resistance, and voltage, select a table that indicates the correct conditions. Standard is 100 percent.

LESSON TOPIC 12.32.3. OPERATIONAL ANALYSES OF SERIES RC AND RL CIRCUITS.

Estimated contact hours allotted lesson topic: learning center, 4.0 hours.

TERMINAL OBJECTIVE

Supported partially by this lesson topic and by lesson topics 12.32.1 and 12.32.2.

When the student completes this course, he will be able to:

32.0. Perform an operational analysis of a series RC filter and a series RL filter in order to determine the effects that changes in the reactive components have on the cutoff frequency, given test circuits, a signal generator, and a VTVM. Observe personal safety precautions and follow proper equipment protection procedures. Standard is within the tolerance of the test equipment.

MODULE 13.0. SERIES RESONANT CIRCUITS

Estimated contact hours allotted this module: learning center, 4.5 hours.

TERMINAL OBJECTIVE

Supported entirely by this module.

When the student completes this course, he will be able to:

33.0. Measure total current in a series RLC circuit in order to determine when the circuit is at, above, and below resonance, and calculate X_C and X_L at the measured frequencies, given the N.E.A.T., device 6, a signal generator, a multimeter, a VTVM, and the necessary instructions. Observe personal safety precautions and follow proper equipment protection procedures. Standard is 100 percent.

LESSON TOPIC 13.33.1. SERIES RLC CIRCUITS AT RESONANCE.

Estimated contact hours allotted lesson topic: learning center, 1.0 hour.

TERMINAL OBJECTIVE

Supported partially by this lesson topic and by lesson topics 13.33.2 and 13.33.3.

When the student completes this course, he will be able to:

33.0. Measure total current in a series RLC circuit in order to determine when the circuit is at, above, and below resonance, and calculate X_C and X_L at the measured frequencies, given the N.E.A.T., device 6, a signal generator, a multimeter, a VTVM, and the necessary instructions. Observe personal safety precautions and follow proper equipment protection procedures. Standard is 100 percent.

ENABLING OBJECTIVES

Supported entirely by this lesson topic.

When the student completes this lesson topic, he will be able to:

33.1.4. DEFINE the resonant frequency of a series RLC circuit by selecting a statement. Standard is 100 percent.

33.1.6. IDENTIFY the effect on total impedance of varying the frequency of a series RLC circuit to slightly above or slightly below resonance by selecting statements. Standard is 100 percent.

33.1.7. DESCRIBE the current in a series RLC circuit at its resonant frequency by selecting statements. Standard is 100 percent.

33.2. SOLVE for true power in a series RLC circuit. Standard is 100 percent.

LESSON TOPIC 13.33.2. VARIATIONAL ANALYSES OF RESONANT SERIES RLC CIRCUITS.

Estimated contact hours allotted lesson topic: learning center, 1.0 hour.

TERMINAL OBJECTIVE

Supported partially by this lesson topic and by lesson topics 13.33.1 and 13.33.3.

When the student completes this course, he will be able to:

33.0. Measure total current in a series RLC circuit in order to determine when the circuit is at, above, and below resonance, and calculate X_C and X_L at the measured frequencies, given the N.E.A.T., device 6, a signal generator, a multimeter, a VTVM, and the necessary instructions. Observe personal safety precautions and follow proper equipment protection procedures. Standard is 100 percent.

ENABLING OBJECTIVES

Supported entirely by this lesson topic.

When the student completes this lesson topic, he will be able to:

33.1.1. DETERMINE the conditions in a resonant series RLC circuit when the applied frequency is varied. Given a schematic and the values of frequency, voltage, and components, select from a table the conditions that occur when frequency is varied. Standard is 100 percent.

33.1.3. DETERMINE the conditions in a resonant series RLC circuit when the inductance is varied. Given a schematic and the values of frequency, voltage, and the components, select from a table the conditions that occur when inductance is varied. Standard is 100 percent.

33.1.2. DETERMINE the conditions in a resonant series RLC circuit when the capacitance is varied. Given a schematic and the values of frequency, voltage, and components, select from a table the conditions that occur when capacitance is varied. Standard is 100 percent.

33.1.5. DETERMINE the effects on voltage measured across the reactive components of a series RLC circuit at resonance by selecting statements. Standard is 100 percent.

LESSON TOPIC 13.33.3. OPERATIONAL ANALYSIS OF THE RESONANT SERIES RLC CIRCUIT.

Estimated contact hours allotted lesson topic: learning center, 2.5 hours.

TERMINAL OBJECTIVE

Supported partially by this lesson topic and by lesson topics 13.33.1 and 13.33.2.

When the student completes this course, he will be able to:

33.0. Measure total current in a series RLC circuit in order to determine when the circuit is at, above, and below resonance, and calculate X_L and X_C at the measured frequencies, given the N.E.A.T., device 6, a signal generator, a multimeter, a VTVM, and the necessary instructions. Observe personal safety precautions and follow proper equipment protection procedures. Standard is 100 percent.

ENABLING OBJECTIVES

Supported entirely by this lesson topic.

When the student completes this lesson topic, he will be able to:

33.3. MEASURE total current in a series RLC circuit in order to determine when the circuit is at, above, and below resonance, given the N.E.A.T., device 6, a signal generator, a multimeter, a VTVM, and the necessary instructions. Standard is 100 percent.

33.3.1. CALCULATE X_L and X_C at the measured frequencies. Standard is within limits of equipment.

MODULE 14.0. PARALLEL REACTIVE CIRCUITS.

Estimated contact hours allotted this module: learning center, 5.5 hours.

TERMINAL OBJECTIVE

Supported entirely by this module.

When the student completes this course, he will be able to:

34.0. Measure total and branch currents in a parallel RLC circuit in order to determine when the circuit is at, above, and below resonance, and calculate X_L and X_C at the measured frequencies, given the N.E.A.T., device 8, a signal generator, a multimeter, a VTVM, and the necessary instructions. Observe personal safety precautions and follow proper equipment protection procedures. Standard is 100 percent.

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LESSON TOPIC 14.34.1. THE PARALLEL RL CIRCUIT.

Estimated contact hours allotted lesson topic: learning center, 0.5 hour.

TERMINAL OBJECTIVE

Supported partially by this lesson topic and by lesson topics 14.34.2, 14,34.3, 14.34.4, and 14.34.5.

When the student completes this course, he will be able to:

34.0. Measure total and branch currents in a parallel RLC circuit in order to determine when the circuit is at, above, and below resonance, and calculate X_L and X_C at the measured frequencies, given the N.E.A.T., device 8, a signal generator, a multimeter, a VTVM, and the necessary instructions. Observe personal safety precautions and follow proper equipment protection procedures. Standard is 100 percent.

ENABLING OBJECTIVES

Supported entirely by this lesson topic.

When the student completes this lesson topic, he will be able to:

34.4.4. DETERMINE the effects in a parallel RL circuit of a variation in applied voltage. Given a schematic diagram and circuit values, select a table that indicates the correct conditions. Standard is 100 percent.

34.4.2. DETERMINE the effects in a parallel RL circuit of a variation in resistance. Given a schematic diagram and circuit values, select a table that indicates the correct conditions. Standard is 100 percent.

34.4.3. DETERMINE the effects in a parallel RL circuit of a variation in inductance. Given a schematic diagram and circuit values, select a table that indicates the correct conditions.

34.4.1. DETERMINE the effects in a parallel RL circuit of a variation in frequency. Given a schematic diagram and circuit values, select a table that indicates the correct conditions. Standard is 100 percent.

LESSON TOPIC 14.34.2. THE PARALLEL RC CIRCUIT.

Estimated contact hours allotted lesson topic: learning center, 0.5 hour.

TERMINAL OBJECTIVES

Supported partially by this lesson topic and by lesson topics 14.34.1, 14.34.3, 14.34.4, and 14.34.5.

When the student completes this course, he will be able to:

34.0. Measure total and branch currents in a parallel RLC circuit in order to determine when the circuit is at, above, and below resonance, and calculate X_L and X_C at the measured frequencies, given the N.E.A.T., device 8, a signal generator, a multimeter, a VTVM, and the necessary instructions. Observe personal safety precautions and follow proper equipment protection procedures. Standard is 100 percent.

ENABLING OBJECTIVES

Supported entirely by this lesson topic.

When the student completes this lesson topic, he will be able to:

34.3.4. DETERMINE the effects in a parallel RC circuit of a variation in applied voltage. Given a schematic diagram and circuit values, select a table that indicates the correct conditions. Standard is 100 percent.

34.3.2. DETERMINE the effects in a parallel RC circuit of a variation in resistance. Given a schematic diagram and circuit values, select a table that indicates the correct conditions. Standard is 100 percent.

34.3.3. DETERMINE the effects in a parallel RC circuit of a variation in capacitance. Given a schematic diagram and circuit values, select a table that indicates the correct conditions. Standard is 100 percent.

34.3.1. DETERMINE the effects in a parallel RC circuit of a variation in frequency. Given a schematic diagram and circuit values, select a table that indicates the correct conditions. Standard is 100 percent.

LESSON TOPIC 14.34.3. THE PARALLEL RESONANT CIRCUIT.

Estimated contact hours allotted lesson topic: learning center, 0.5 hour.

TERMINAL OBJECTIVES

Supported partially by this lesson topic and by lesson topics 14.34.1, 14.34.2, 14.34.4, and 14.34.5.

When the student completes this course, he will be able to:

34.0. Measure total and branch currents in a parallel RLC circuit in order to determine when the circuit is at, above, and below resonance, and calculate X_L and X_C at the measured frequencies, given the N.E.A.T., device 8, a signal generator, a multimeter, a VTVM, and the necessary instructions. Observe personal safety precautions and follow proper equipment protection procedures. Standard is 100 percent.

ENABLING OBJECTIVES

Supported entirely by this lesson topic.

When the student completes this lesson topic, he will be able to:

34.2. DEFINE the natural resonant frequency of an ideal parallel LC circuit by selecting the definition. Standard is 100 percent.

34.2.1. IDENTIFY the impedance of a parallel LC circuit at resonance in reference to the circuit and to the tank, by selecting statements. Standard is 100 percent.

34.2.2. IDENTIFY the impedance of a parallel LC circuit above and below its resonant frequency, by selecting statements. Standard is 100 percent.

34.2.3. DETERMINE the current in a parallel LC circuit at its resonant frequency, by selecting statements. Standard is 100 percent.

LESSON TOPIC 14.34.4. VARIATIONAL ANALYSIS OF THE PARALLEL RESONANT CIRCUIT.

Estimated contact hours allotted lesson topic: learning center, 2.0 hours.

TERMINAL OBJECTIVES

Supported partially by this lesson topic and by lesson topics 14.34.1, 14.34.2, 14.34.3, and 14.34.5.

When the student completes this course, he will be able to:

34.0. Measure total and branch currents in a parallel RLC circuit in order to determine when the circuit is at, above, and below resonance, and calculate X_L and X_C at the measured frequencies, given the N.E.A.T., device 8, a signal generator, a multimeter, a VTVM, and the necessary instructions. Observe personal safety precautions and follow proper equipment protection procedures. Standard is 100 percent.

ENABLING OBJECTIVES

Supported entirely by this lesson topic.

When the student completes this lesson topic, he will be able to:

34.1.1. DETERMINE the conditions in a parallel resonant LC circuit when the applied frequency is varied. Given a schematic and the values of frequency, voltage, and the components, select a table that indicates the correct conditions. Standard is 100 percent.

34.1.2. DETERMINE the conditions in a parallel resonant LC circuit when the capacitance is varied. Given a schematic and the values of frequency, voltage, and the components, select a table that indicates the correct conditions. Standard is 100 percent.

34.1.3. DETERMINE the conditions in a parallel resonant LC circuit when the inductance is varied. Given a schematic and the values of frequency, voltage, and the components, select a table that indicates the correct conditions. Standard is 100 percent.

LESSON TOPIC 14.34.5. OPERATIONAL ANALYSIS OF THE PARALLEL RESONANT CIRCUIT.

Estimated contact hours allotted lesson topic: learning center, 2.0 hours.

TERMINAL OBJECTIVES

Supported partially by this lesson and by lesson topics 14.34.1, 14.34.2, 14.34.3, and 14.34.4.

When the student completes this course, he will be able to:

34.0. Measure total and branch currents in a parallel RLC circuit in order to determine when the circuit is at, above, and below resonance, and calculate X_L and X_C at the measured frequencies, given the N.E.A.T., device 8, a signal generator, a multimeter, a VTVM, and the necessary instructions. Observe personal safety precautions and follow proper equipment protection procedures. Standard is 100 percent.

ENABLING OBJECTIVES

Supported entirely by this lesson topic.

When the student completes this lesson topic, he will be able to:

34.5. MEASURE total and branch currents in a parallel RLC circuit in order to determine when the circuit is at, above, and below resonance, given the N.E.A.T., device 8, a signal generator, a multimeter, a VTVM, and the necessary instructions. Standard is 100 percent.

34.5.1. CALCULATE X_L and X_C at the measured frequencies. Standard is 100 percent.

ANNEX I

BIBLIOGRAPHY

ANNEX I - TEXT MATERIALS

MILITARY PUBLICATION	COMPLETE TITLE
NAVPERS 10086-B	*Basic Electricity*
NAVPERS 10087-C	*Basic Electronics*, Volume 1

ANNEX II

EQUIPMENT
REQUIREMENTS
LIST

ANNEX II - EQUIPMENT

Type Designator	Nomenclature	Federal Stock Number	Quantity Required	Per Item Cost
(AN/number)	Noun name	FSN or manufacturer's part number if no FSN assigned		
Simpson 260-5P	Multimeter	4G6625-135-9839	560	$118.00
WO-33A and B	Oscilloscope	Open purchase	295	158.70
AN/USM-34 WV-77E	Vacuum-tube volt	6625-643-1769	465	
Eico 377	Signal generator	Open purchase	495	70.00
Sureite	Basic voltmeter	Open	110	10.00
Sureite MOD 850	Basic ammeter	Open	75	10.00

ANNEX II - TRAINING AIDS

AS LISTED IN INDEX TO DIRECTORY OF NAVAL TRAINING DEVICES
COGNIZANCE SYMBOL "2 0"

Nomenclature	Federal Stock Number	Device Designator Number	Quantity Required
Tape player	NA	VOM 752/AV	180
Microfiche	NA	Vantage I	275
Projector, Besseler Static Motion	NA	Kodak	108
Headsets, Telex for Norelco 2200	NA	Model 610-1 600Ω	300
Projector, Supermatic 60, w/sound	NA	Kodak Cog 20-4G70	
Tapeplayer	NA	Norelco 2200	
Headsets for VOM 752/AV	NA	PAD Mx-250 /AIC	

ANNEX II - TRAINING AIDS EQUIPMENT

Nomenclature	Federal Stock Number	Device Designator Number	Quantity Required
AS LISTED IN INDEX TO DIRECTORY OF NAVAL TRAINING DEVICES			
COGNIZANCE SYMBOL "2 0"I			
N.E.A.T. power transfer panel 9	Contract number N00123-69-C-1413	6B17/9	100
Resistor board	Local manufacturer		95
Vector board	Local manufacturer		150
N.E.A.T. 2 (modified)	6910-00-943-1151	6B17	375
N.E.A.T. 5 (modified)	6910-00-943-1154	6B17	100
N.E.A.T. 6	6910-00-943-1156	6B17-6	100
N.E.A.T. 8	6910-00-943-1158	6B17-8	100